

SCIENCE

FRIDAY, DECEMBER 30, 1887.

THE PILOT CHART OF THE NORTH ATLANTIC OCEAN for December, issued by the United States Hydrographic Office, calls special attention to the importance of an understanding among transatlantic steamship companies and captains relative to the routes followed by eastward and westward bound vessels, in order to diminish as much as possible the dangers of collision on this great race-track of the 'ocean greyhounds.' A reprint from the chart is devoted to a brief discussion of the routes recommended this month, with the addition of a chart showing graphically their positions relative to the December storm-belt; storm-tracks are plotted by means of dotted lines; and the average force and frequency of prevailing winds in each 5° ocean square north of the 40th parallel are also given, as indicated by the results of the international system of simultaneous meteorological observation, so far as now available. It is an appropriate time to bring up this subject, now that the proposed international conference relative to the increase of safety at sea bids fair to be held. The well-known 'steam-lanes' planned by Maury in 1855 at the suggestion of Capt. R. B. Forbes have never been followed to any great extent, and indeed were never obligatory. At present each captain is allowed to use his own discretion to a very large extent, and almost every consideration is secondary to the desire to 'beat the record' by making a fast passage. If the thousands of passengers who cross the ocean every season could read the thoughts of their captains during the sleepless nights they pass on the bridges of their vessels, while rushing at full speed through a dense fog, it would hardly add to their comfort. The hydrographer, in his recommendations, marks out a new policy, and instead of the old lanes plots two routes on the chart, — eastward-bound vessels to follow the southern line, or nothing to the northward of it; and westward-bound vessels the northern line, or nothing to the southward of it; the two lines crossing the 50th meridian in 45° and 46° north latitude respectively. This is regarded as the best and only practicable solution of the question likely to meet with general acceptance, all things considered. The great difference between this plan and Maury's lanes is in the much wider limits allowed, which are thought to be necessary and reasonable on account of present conditions of navigation, the different destinations of vessels, the increased knowledge and better forecasting of the weather, and the necessity of room to allow for change of course in avoiding storms whose probable paths are now comparatively well known. The prompt use which is thus made by the Hydrographic Office, of the results of the simultaneous observations made by international agreement and published by the United States Signal Service, shows an appreciation of this important system of observation which is especially gratifying as indicating that the collection of these observations from masters of vessels will be energetically continued, now that it is in the hands of this office. It is understood that General Greely has, at the request of Commander Bartlett, ordered the immediate compilation of ten-year normals for each ocean square in the North Atlantic, for use in connection with the Pilot Chart; and the vast interests involved make this subject of such paramount importance, that it is a cause for congratulation that the United States has taken the lead not only in the inauguration of the system and the collection and publication of the observations, but also in the immediate and practical utilization of the results.

THERE IS IN SESSION this week at Trenton, N. J., a body which is something of a novelty in educational organizations, but from which great good is expected. We refer to the New Jersey Council of Education. We do not know of the existence of any similar body in any other State, and we do not believe that the organization of the New Jersey Council is as yet very well or generally understood. In his presidential address at the meeting of the New Jersey State Teachers' Association last year, Superintendent C. E. Meleney of Paterson advocated the formation of a State council of education which should have general unofficial supervision over the educational interests and educational legislation of the State. The idea proved to be a popular one, and a committee was appointed to prepare a plan for the organization of the council. The body has since been regularly organized, and is now holding its first annual meeting. Its constitution lays down as its aims the investigation and discussion of topics relating to education, the dissemination of information bearing on these topics, the consideration and recommendation of the best means of advancing the educational interests of the State, and the consideration of means by which the policy of the State may be modified in view of the progress of educational thought. The constitution limits the membership to forty-eight, and these are divided into three classes, each class to serve three years. The places of the sixteen whose terms expire each year are to be filled at the time of the meeting of the State Teachers' Association. The election of members rests with the council itself, but one-half of the nominations to fill vacancies are to be made by the State Teachers' Association, and one-half by the council. The names of the present members of the council show that its deliberations are to be participated in by representatives of every phase of education, from the sub-primary to the university. The council proposes to be the embodiment of the power of the teaching profession of the State, and will unquestionably do a great service in the cause of educational advancement. The present president of the council is Superintendent W. H. Barringer of Newark, and his address at the present meeting was to be on 'Education as a Problem.' The various working committees and their chairmen are as follows: school organization, Principal B. C. Gregory of Newark; course of study, Superintendent C. E. Meleney of Paterson; high schools and colleges, President Merrill E. Gates of Rutgers College; normal and training schools, Principal J. A. Reinhart of Paterson; supervision of schools, Superintendent Charles Jacobus of New Brunswick; school law, Principal J. M. Green of Long Branch; examination and tenure of office of teachers, Superintendent Randall Spalding of Montclair; hygiene and sanitation, Prof. S. A. Farrand of Newark; moral education and discipline, Dr. J. H. Vincent of Plainfield; statistics, Mr. A. Scarlett of Burlington; industrial education, President Nicholas Murray Butler of Paterson. It will be seen at a glance that the New Jersey Council is a working, not a talking body, and the example it sets could well be followed in other States.

THE RECENT MEETING of the American Public Health Association at Memphis, Tenn., of which a summary has been given in *Science*, was one of the most interesting and important which that association has ever held. Nine years ago its members convened in Richmond, Va., many of them having just come from cities which had been almost decimated by yellow-fever, first among which was Memphis itself. The National Board of Health had its birth in this meeting; and had the same broad and liberal spirit which characterized that meeting been fostered and encouraged, that board

would doubtless be in existence to-day, having had nearly ten years of experience, which would have enabled it to cope with any epidemic which might visit our shores. But petty jealousies arose, and as a result that board has now no existence. Its work was of the best, and five volumes of its records attest this fact. The need of a national health department in some form was dwelt upon at length by the president, Dr. Sternberg, in his address. He thinks that at the present time it would be useless to ask that the sanitary interests be placed under the charge of another cabinet officer, a minister of public health, but that sanitarians should demand that their interests receive the same consideration from the national government as is accorded to the educational and industrial interests of the country. He recommends the organization of a bureau of public health, with a commissioner at its head, with the necessary assistance to make it efficient. It has been suggested that a board of health would be better than this plan contemplates, its members coming from different sections of the country. Dr. Sternberg is right, we think, when he speaks of such a board as not calculated to do the best work. Another plan is to have such a board made up of the surgeon-generals of the army, navy, and marine-hospital service; but these officers are already fully occupied with their duties, and could not with advantage undertake the executive work of a central health bureau. Such a board would act well as an advisory body, but its work should be limited to that. It is sincerely to be hoped, that, as a result of the discussion of this important question, the next Congress will provide for a central health organization. Such action would meet with the hearty support of sanitarians throughout the United States, and would do much to quiet the minds of these gentlemen who to-day look with anxiety and concern upon the possibilities which might occur should cholera or other epidemic disease visit this country in the present unsettled condition of its sanitary administration.

SNOW HALL OF NATURAL HISTORY AT LAWRENCE, KAN.

THE Legislature of the State of Kansas, during its biennial session of the year 1885, appropriated fifty thousand dollars for the purpose of erecting a natural history building for the University of Kansas. The erection of such a building was rendered imperative by the extensive botanical, entomological, zoölogical, and geological collections brought together under the supervision of Prof. F. H. Snow, whose connection with the institution dates from its foundation in the year 1866. The building was completed in the autumn of 1886, and was formally named and dedicated to the purposes for which it was erected, on Nov. 16 of that year. It has two principal stories, each sixteen feet in height, together with a basement and attic so commodious and well lighted as to make the structure practically four stories in height. The building from basement floor to attic roof is divided into two portions, partially separated from each other by the main entrance-hall and stairways. The portion to the west of the entrance is devoted to the exhibition of the various cabinets, while the opposite portion is assigned to the work of instruction. The collections belonging to each department are upon the same floor with the laboratories of that department, easily accessible to both students and instructors. The arrangement of the various apartments is so well indicated in the accompanying plans as to require no verbal description. This arrangement was suggested by Mr. J. H. Emerton of New Haven, Conn., who furnished the preliminary plans which formed the basis upon which the Legislature was solicited to make the appropriation. Mr. Emerton's outlines were placed in the hands of Architect J. G. Haskell of Topeka, Kan., who completed the architectural adaptations in the matters of construction, light, heat, ventilation, and exterior style, in a successful and satisfactory manner. The rooms most naturally grouped themselves so as to form a rectangular building; but for the purpose of increasing the volume of light, and also improving the architectural effect, their form was somewhat changed.

The building is most admirably lighted; the volume being so

great that on a cloudy day the occupants of laboratories need not seek proximity to the windows for microscopical work, and the museum halls may have cases arranged in any desired relation. The large museum rooms are lighted on three sides, and necessarily have one side not lighted. To prevent this from being a dark side, a plate-glass window, eight feet wide and eleven feet high, opposite the centre of the unlighted wall, was added to the ordinary means of lighting, and has the effect of giving uniformity of volume throughout the entire space.

The exterior is in the Romanesque style, with rock-face ashlar and cut stone dressings, the stone being from the well-known Cottonwood quarries of Kansas. The main approach is by a broad flight of buttressed stone steps under a handsomely decorated portico, the decorations being suggestive of the uses of the building. Numerous stone panels are provided about the building, which may, if desired, be utilized for illustrations of natural history subjects cut in bas-relief.

The construction of the building is nearly fire-proof. All bearing-girders are of iron, and all floors are deadened with mortar on corrugated iron laid between the joists. All partitions are non-combustible, all lathing is of wire cloth, the roof is covered with slate and dressed with iron cornices, ridge and hip rolls. All interior finish is polished hard wood, so that little material is presented to feed combustion.

Heating is by steam, the 'indirect' method being employed to furnish the rooms with warm fresh air, and the 'direct' method for securing proper temperature.

Fresh air is introduced into the building by means of a 'plenum' extending under the entire building, and connecting with the outer air by arched openings and areas. Ventilation is accomplished by means of large flues leading from near floor and ceiling of all rooms to a large iron chamber in the attic, in which sufficient radiation is located to insure a successful movement of the foul air through a ventilating cupola to the exterior.

The construction of the building was by contract with McFarland & Son of Lawrence, and completion was accomplished within the prescribed appropriation, and without 'extras.'

INDIAN WHEAT.

At a recent meeting of the English Farmer's Club, Professor Wallace of Edinburgh University read a paper on agriculture in India.

Professor Wallace said he went to India not only to study agriculture in view of the important influence it was likely to exercise over British agriculture, and forestry in view of the likelihood of a chair of forestry being established at his university, but he had the further object of wishing to see for himself why it was that the government had practically given up the idea of improving Indian agriculture. He found that the apathy on the part of the government in the direction of advancing agriculture was exhibited not only in the case of the native scholars, but was general. Practically all that was left of the Agricultural Department was the name, and this was not always recognized in the presidencies. The ryots' faith in the proposals of the government to improve their practices had entirely vanished. The speaker then went on to explain the character of the Indian cattle, and showed that these were raised, not for meat, but for sinew; and he pointed out the lessons to be learned from color, the black cattle better resisting heat. As to the wheat-growing, he said, that, in order to produce wheat for the market, the ryots increased the area cultivated by taking in more land from the wastes or jungle the most convenient, in the first instance, to their holdings; but, in addition to this, they grew wheat in many cases in place of some other crop. There was a limit to the extension of the so-called 'substitution' wheat area; and the area of extended wheat-growth was, as time went on, always becoming more difficult to increase, and, even after difficulties are surmounted, less remunerative. A tract of country where extension would be the main source of wheat-supply skirted the eastern border of the desert of north-western India. Supplies of wheat were also expected to be forthcoming from the rich black soils of the southern Mahratta country when the railway communication was better established. It had been thought by some that the future supplies of Indian wheat would so increase as to flood the English markets to

overflowing. He did not deny that Indian wheat would for many years remain a substantial item in the annual wheat imports, but there was no indication that the amount of it would increase at any thing like an alarming rate. With the extension of railways, new wheat-growing districts would be tapped, but the supply of easily available land was by no means unlimited, and the drawbacks and disadvantages were far more numerous than most people supposed. He then commented upon the likelihood of the yield decreasing and the quality degenerating by too frequent growth on the same land. He believed that the land was not seriously impoverished by the native systems of rotation, or by the practice which they had of growing mixed crops; but it would be strange if they altered those time-honored practices, and grew wheat year after year with successful results, as if the land were in the condition of virgin soil. It had been the history of every great wheat-growing region that the yield and quality came down if the land was not kept up by manuring, as in England. He cited America as a typical example. The point where the best wheat grew had steadily marched westward, and he claimed that it had left as a record of its course the ruins of disused and deserted mills. It is not perfectly clear wherein he has evidence of this. Sir Donald Mackenzie Wallace, the author of 'Russia,' and now private secretary to the viceroy of India, related an excellent illustration of the case in point. A district in southern Russia was suddenly stricken with the wheat-growing mania. For a few years the yield, for size of grain, quality, and quantity, was simply marvellous; in a few more years the excess in every way became normal; and in yet a few more years, the produce diminishing in every respect, it became impossible for wheat-growing to continue, and the people had to go back to their rye-crops and other coarser grains. He dealt with the character of the wheats grown in India, and commented upon their inferiority in several respects.

Sir James Caird, in thanking Professor Wallace for his interesting lecture, said that he thought Mr. Wallace had not given as much credit as they deserved to the various agricultural departments in India for their exertions. But in a country so populous, and with an agricultural practice to a certain extent established by a long line of experience of climate and soil, the cultivators have not been slow to avail themselves of the extending facilities of transport, which, in regard to cost on the great railway-lines in India, are now brought very much on a par with the charges in America. An increasing demand, caused by facility of transport, has stimulated production, and has shown that instruction in the art of agriculture is not so much required as access to good markets. India has a great variety of products, and though wheat interests British agriculturists more than any other, cotton stands highest on the list of exports, next to it opium, then oil-seeds, then rice, and fifth wheat. But wheat had, no doubt, gained the most increase of any. The rapid extension of exports of native produce from India in the last ten years is, indeed, very remarkable. The total value in 1877 was sixty-five millions sterling, and in 1886 eighty-five millions, — an increase of nearly thirty per cent. There could be no great deficiency in the knowledge of the cultivators where such a result was possible; and probably the best aid that the government of India could give to native agriculture would be to proceed steadily with the construction of railways in all the richer parts of that vast country which are still without them. With regard to a continued supply of wheat to Europe, he agreed with Professor Wallace that there is neither the same facility for its increased production as in America, nor the same likelihood of a surplus. The population of India and the native states at the last census was two hundred and fifty millions. It is believed to be increasing at a rate which, in ten years, might add twenty million more mouths to be fed. This increase must be provided for, and the periodical return of famines must not be forgotten. We are within a short period of the time when one will be due. He did not, therefore, think that Europe could depend on India so much as America for future supplies of wheat.

HEALTH MATTERS.

Quarantine Systems.

THE quarantine systems of the United States were fully discussed at the Memphis meeting. For years that of New York has been

regarded as the best which could be found along either coast, and its methods have been copied by the quarantine officers of other ports. The condition, however, in which the quarantine arrangements were found to be, when the 'Alesia' and 'Britannia' arrived last fall with cholera on board, has done much to destroy the confidence which up to this time had been reposed in the New York system. For the defects which then existed, and many of which doubtless still exist, the responsibility has not yet been determined. The health-officer places it upon the governor of the State, inasmuch as he has vetoed appropriations which were needed to put the hospital islands and appliances in fit condition to receive immigrants suffering from epidemic disease. On the other hand, it has been attempted to throw the blame on the health-officer himself for not supplying what was needed at his own expense. This latter criticism is unjust. He is not called upon, either as a matter of obligation or duty, to expend the amounts necessary to remedy the defects, and certainly there is no precedent for it either at the port of New York or elsewhere.

During nearly fifteen years of active connection with health organizations, the writer can recall but one instance in which a sanitary official paid out of his own pocket the amounts necessary to prosecute sanitary work, when the authorities failed or refused to appropriate public funds for that purpose. That official was Dr. Davenport of Boston, chemist and milk-inspector of the board of health. The amount expended was, if we remember correctly, more than three thousand dollars, and the last we heard he had not been repaid. If there are other instances, we should be glad to put them on record.

The Philadelphia committee reflected very severely on the management of the quarantine authorities at New York, and their complaints have not been fully met. It appears, however, that cholera has not spread from the hospital islands, and it is to be hoped that the measures taken to extinguish it have been successful. The systems at Baltimore and Philadelphia have been condemned as entirely inadequate to the task of coping with epidemic disease should it make its entrance at either of these ports. These defects were the foundation for the request, made especially by Western sanitarians, that a national quarantine system should be organized, whose restrictions should be similar at all the ports of the United States, thus leaving no port unprotected, but keeping such a vigilant watch over all, that cholera and yellow-fever might with certainty be excluded.

The quarantine system of Louisiana has been brought to such a state of perfection by Dr. Joseph Holt, president of the State Board of Health, that it is now looked upon as the best in the United States. A description of this system was given by Dr. Holt at the Memphis meeting, and is a part of the report of the committee on disinfectants. In this description the writer says there are three maritime approaches to New Orleans, — the Mississippi River, the Rigolets, and the Atchafalaya River. The two latter are closed against all vessels from quarantined ports, compelling such to use the Mississippi as the only available route to New Orleans. The quarantine is a system composed of three stations, the first of which is an advance-guard inspection station situated at Port Eads, one hundred and ten miles below New Orleans. Here vessels are boarded by the medical officer, who inquires as to their sanitary record and present condition. If from a non-quarantined port, and all is well, they go to the city. If a vessel comes from a quarantined port, but gives no evidence of present or past sickness among passengers or crew, she proceeds to the upper station, seventy miles below the city, where she is subjected to sanitary treatment. If, on the other hand, the vessel gives evidence of being infected, she is sent to the lower station, located on Pass à l'Outre, one hundred and three miles below New Orleans. The sick are at once removed to a hospital. The vessel, with the well on board, is thoroughly disinfected by the aid of the quarantine tugboat. The atmosphere below decks is completely replaced with one heavily charged with sulphurous oxide, and wherever possible a solution of bichloride of mercury is applied to effect thorough disinfection.

In speaking of this treatment, Dr. Holt says, "A ship known to be infected with one of the three great pestilential diseases — small-pox, cholera, or yellow-fever — can stand and must endure extraordinary treatment, even if clothing is wetted and some articles

damaged. 'They who go down to the sea in ships' assume the perils of the voyage, among which is this occurrence of finding themselves on an infected vessel, and being compelled to undergo a cleansing; for they have no right to bring their perils ashore and endanger others." The ship, with those on board, is held ten days for observation, and then allowed to proceed to the upper station, where she undergoes further treatment, and then goes to the city.

The methods practised by Dr. Holt are very thorough, and in their application, a tugboat, fitted up with all the necessary machinery, is employed. The bedding of the vessel, together with cushions, mattresses, carpets, rugs, etc., is removed from the ship to a commodious building in close proximity to the disinfecting wharf, where they are treated by moist heat at a temperature of not less than 230° F. During this process of steaming, every article is perceived to be saturated and intensely hot, the steam freely penetrating to the interior of mattresses, double blankets, etc.; but so great is the heat in the texture of the fabrics as to immediately expel all moisture upon drawing the racks and exposure to the open air. Shirts and collars instantly assume the crisp dryness they possessed before exposure, losing the musty smell of long packing in a trunk. Silks, laces, and the most delicate woollen goods show no signs of injury whatever from the treatment. Articles of leather, rubber, and whalebone would be injured by the heat, and are therefore disinfected with the bichloride-of-mercury solution. The time required to charge the chamber with apparel for disinfection is thirty minutes; time required for action of moist heat, twenty minutes; for removal of articles, fifteen minutes,—a total of sixty-five minutes.

The report of Dr. Holt is amply illustrated with figures of the apparatus used in disinfection, and the method of its application, and should be in the possession of every sanitarian as furnishing a model which can be adapted to the requirements of every quarantine station.

MENTAL SCIENCE.

Ideas of Number in Animals.

THE study of comparative psychology labors under two difficulties: the facts upon which it is to build cannot be accurately ascertained without great difficulty; and the interpretation of the facts is a still more delicate and laborious task. Civilized man has looked upon the facts of nature with so entirely a modern mind, that it is a rare gift to be able to appreciate the elementary thought-processes of uncivilized communities or of animals. Every attempt at improving the methods of presenting these phenomena should be received with sympathetic consideration, without regarding as final what is probably only a step to something better. Mme. Clemence Royer has recently made a study of the mathematical powers of animals that deserves the consideration of all students of psychology.

Among men we find all grades of mathematical ability, from that of a Newton and Laplace to that of one who cannot conceive the abstract notion of number. What the savage lacks is not the knowledge of the difference between three men and ten men, but the power to abstract the notion 'three' from men, trees, hands, and so on. The first step in this process is the distinction of unity from plurality, then of duality, etc., from plurality. The relic of this appears in the prevalence of the dual number in rudimentary languages.

What impresses itself upon the primitive mind is the sensory images of objects: he knows the difference between four trees arranged in a quadrilateral and in a row, between the general look of three trees and of four trees, but cannot see any thing in common between four trees and four stones. He is a poor arithmetician, but a good geometer; he is impressed by space relations, not by numerical characteristics. He can judge of distance, of the outlines, of the sizes of objects, but all by an instinctive visual talent. If, then, arithmetical notions appear late in human development, we can hardly expect it to be prominent among animals, lacking an intellectual language. What we can speak of as the language of animals is limited to the expression of the emotions. Their mathematical distinctions are sensory in nature. They distinguish between unity and plurality of certain objects, but we cannot credit

them with abstract notions of 'one' and 'two.' They have a kaleidoscopic, photographic memory, not an abstract verbal one. All the wonderful powers of animals finding their way, of regularity in time, must be accounted for by an accuracy in the perception of outlines, and the unconscious registration of general intervals by feelings of fatigue, number of steps, and so on.

There is no unit of distance or time. Distance is to them a perception, not an idea. Just so a dog, in attacking a boar, accurately judges the length of his leap, the size and strength of the enemy; but this does not involve any mathematical calculations. The apparent understanding of language by trained dogs comes under the same head. The dog does not appreciate the phonetic value of the words, but takes his clue from the intonation, the little gestures, and the like. The horse understands the 'language of the bit' better than that of his master. Animals, in brief, have their geometrical sense of relations well developed (better than men in some respects), but are not arithmeticians.

They do not, however, lack all appreciation of number. They do distinguish between numbers, for this is necessary to their existence; but their distinction, when it goes above a few simple units, is in the form of a bunch-estimate, depending as much on the arrangement of the group as on its size. They cannot estimate as we do when we divide an army into regiments, into companies, and so on, and thus estimate the number of men.

Birds, it is true, are much alarmed if an egg be removed from their nests, but they are equally alarmed if the arrangement of the eggs be disturbed; thus indicating that it is the general disturbance that causes the alarm, not a counting of the eggs. The mother recognizes her young individually, and thus can notice the absence of one; but she probably sees no more difference between the eggs than we do, and judges their number only by their arrangement. Cats probably distinguish their young by differences in the fur, and so on: they are little affected if one kitten be removed; but, if more than four be taken away, they are greatly disturbed, and especially so if but one be left. If the kittens are weaned, the loss is not taken so seriously.

Dogs notice the absence of one of their number; but that they recognize each other individually is shown by their preferences and jealousies, both among themselves and towards men. Shepherds' dogs do not count their fold, but simply have a general picture of its size. Likewise trained dogs do not count, but have simply learned to associate mechanically certain geometrical forms with certain actions. Sir John Lubbock's dog, that brings a different label according as it wants something to eat, to go out, and so on, does not appreciate the intellectual value of the letters, but regards the label as an artificial means for gaining certain ends. The dog's faculties in these respects, however, seem to be not inferior to those of the Bushmen, who count only to two, and call all above that 'many.' Number is here concrete only with reference to objects where plurality is a useful trait: it is never abstract, and so can no more reach the stage of mathematical art than can their emotional language reach the stage of ideational abstraction to which ours has attained. By this is not meant that animals can form no abstract notions, but that their general notions are very limited in scope, and are along the line of directly useful interests only. The animal thinks by generic images, does not err in its judgments, is not liable to fallacies, all of which are distinctly human because we think by the intervention of words; and this difference forms the difficulty of our communication with them.

Animal-trainers have ignored these facts, not recognizing that geometry is more fundamental than arithmetic, and have attempted to make animals arithmeticians when nature has made them geometers. Ourselves accustomed to look on every thing from its numerical aspect, we fail to see how trivial a part this plays in animal life.

There remains the consideration of number, not of objects in space, but of succession in time. This faculty has been claimed for the higher animals. There are many stories of pets keeping up the same action at regular intervals, and always the same number of times per day or per week,—the story of a dog who always wanted three pieces of sugar, of the dog who would always keep out of the way on Sunday, and so on. Mme. Royer explains this as due to ordinary associations without the intervention of abstract

notions of time-units. Houzeau took his dogs out walking every alternate day, and after ten walks did not notice a spontaneous desire of the dogs to go out, although they enjoyed the walk. The dogs did not estimate the interval, but took hints from trifling indications. They notice the return of a complex series of circumstances. On the other hand, Houzeau ascribes an instinctive time-sense to the crocodile that comes back to its eggs after a definite interval, varying from ten to fifteen days in different species. The mules on the horse-cars in New Orleans make five trips a day, and are always very restless on completing their fifth trip. Such facts need more exact experimentation before they can be ascribed to real counting on the part of the animals.

THE INFLUENCE OF SENSATIONS ON ONE ANOTHER. — Under this head Dr. Urbanschitsch of Vienna reports some curious experiments, the value of which must be left to future research to decide. His general conclusion is, that the excitation of one sense-organ increases the acuteness of the others. If a disk be regarded at such a distance that its color is indistinct, the hearing of a sound will bring out the color. The beating of a watch is heard more clearly with the eyes open than with the eyes closed. Red and green increase auditory perceptions; blue and yellow weaken them. The fact that we listen to music with our eyes closed is due to other reasons, and also to the fact that the *ensemble* appears best when the tones are not at their clearest. Smell, taste, and touch are open to the same influence. Red and green increase the sensitiveness of each of these senses; yellow and blue weaken their sensitiveness. Touch and temperature have a reciprocal influence. If one tickles the skin and plunges it into warm water, the tickling ceases; if into cold water, the tickling brings out the feeling of cold. These observations are regarded as showing the same re-enforcing action between sensations as has been shown to exist between motions, and as offering a mode of explanation of those curious associations between colors and sounds so insistent in some minds.

BOOK — REVIEWS.

Greek Life and Thought, from the Age of Alexander to the Roman Conquest. By J. P. MAHAFFY. New York, Macmillan. 12°. \$3.50.

THIS work is in the main a continuation of the author's previous volume, 'Social Life in Greece from Homer to Menander,' though somewhat wider in its scope. It lacks the absorbing interest that belongs to the history of the great days of Greece, but it has a new interest of its own in the spread of Hellenic civilization in Egypt and western Asia. The work is not confined to the moral and social life of the times, though this is the most prominent feature, but contains a great amount of information and discussion on almost every phase of Hellenic life. The political interest of the age immediately succeeding the death of Alexander centres partly in the division of his empire into various kingdoms, and partly in the struggles of the cities in European Hellas to recover their independence. Of the various kingdoms of the Hellenistic world, Egypt was, in Mr. Mahaffy's opinion, the most important and the most prosperous, — a fact which he attributes in great part to the statesmanlike genius of its founder, the first Ptolemy. In dealing with the cities of Greece, the author shows a lack of sympathy with the spirit of freedom and local patriotism which is not quite creditable in a citizen of a free country and a historian of Hellenism. It is true, the struggles of the cities to regain their autonomy proved unavailing, and perhaps they were not sufficiently cosmopolitan in their views; yet freedom is better than empire, and, while we acknowledge the defects and the failure of the patriots, we cannot but sympathize with their misfortunes.

Of the moral life of the period, we get glimpses from many points of view, and yet, as a whole, it is somewhat difficult to judge. The sins of the royal courts, especially the frequent murders, the use of torture, and the perpetual wars, are sufficiently prominent; yet Mr. Mahaffy thinks that the morality of private life was purer and more refined than it was in earlier times. In one respect there was certainly a real moral advance: it was during this period that the great schools of ethical philosophy were founded, and men came to regulate their lives by reason instead of by tradition and custom.

The author gives an interesting account of the philosophical schools at Athens, which were established by law as religious corporations with regular endowments; and he shows clearly that during most of the period under review they were highly respected and influential.

The intellectual life of the Hellenic world is treated by the author with considerable fulness. The history of physical and mathematical science is omitted, on the ground that the author lacks the special knowledge requisite for treating it. In art the Rhodian and Pergamene schools are, of course the most conspicuous; and Mr. Mahaffy shows, that, though this was an age of decadence, the number of excellent artists was by no means small. In literature, after the decline of the New Comedy at Athens, the chief interest centres in Alexandria. The establishment of the Museum and the great library in that city, and the liberal patronage of both by the Ptolemies, made the place the chief seat of literature, as it afterwards became of philosophy. Of the quality of this literature, Mr. Mahaffy expresses the opinion usually held of it by modern scholars. It was distinguished by erudition and imitation of earlier models rather than by original genius or power of style. It is worthy of note, however, that it was at Alexandria that the practice arose of writing poems, and afterwards prose fictions, on the theme of romantic love, — a theme which has since become the most prolific in literature.

The concluding chapter of the book gives an account of the introduction of Hellenic civilization into Rome consequent on the conquest of Greece by the Roman arms; but the subject is only just introduced, as the author intends writing another work on the spiritual life of Hellenism in the Roman Empire. Those who have read his other works will look with interest for the promised volume.

Mount Taylor and the Zuñi Plateau. By Capt. C. E. DUTTON. Washington, Government. 4°.

STUDENTS of American geology who have learned to expect in Captain Dutton's contributions important results ably elaborated, and presented in a style which is simply fascinating, — clear and graphic, and worthy of the geological wonderland in which it has been his fortune to work, — will experience no disappointment in this paper. The district to which it relates (longitude 107° to 109°, and latitude 35° to 36°) lies in the western part of New Mexico, and in the south-eastern corner of the great plateau country, and embraces two distinct geological problems of the first order, — the volcanic region of which Mount Taylor is the culmination, and the Zuñi Plateau. Captain Dutton's previous studies, as well as those of Gilbert, Powell, and others, were confined mainly to the western side of the plateau province, and especially to the portion traversed by the Grand Cañon of the Colorado. But although no geologist possessing any breadth of comprehension could enter the plateau country, and, after gaining an extended knowledge of its physical features, fail to perceive that it is a great unit, and sharply delimited from every thing which surrounds it, it was still extremely desirable to study the south-eastern extensions of these vast masses of strata and the features carved out of them, in the hope that problems which could be only half solved on one side of the plateau could be completely solved on the other. It was felt that the history and evolution of this unique region could be ascertained satisfactorily only by knowing the whole. The survey, therefore, embraced the first opportunity of attacking it from the eastern side; and the admirable monograph before us sufficiently attests the wisdom of this policy.

With the view of putting this new field at once into its natural relations with the whole of which it forms a part, Captain Dutton begins with a summary account of the plateau country in its entirety. The area of the plateau country, south of the Uinta Mountains, is about one hundred and thirty thousand square miles. A shaded map shows its form and its position with reference to the other portions of the western United States. The topographic features and extraordinary scenery of this region have been described many times, and it is deemed needless to descant upon them; but several pages are devoted to the general geologic features underlying these wonderful reliefs. The strata are normally approximately horizontal; and such slight inclinations as occur are very persistent, car-

rying the strata from very high altitudes to very low ones. But no structural features of the plateau country are more truly characteristic than the monoclinical folds and faults.

The marginal portions of the plateau country abound in volcanic rocks and extinct volcanoes, while they are almost wholly wanting in the great central areas. The eruptions vary in age from the middle eocene almost to the present, the latest being probably less than three centuries old. This volcanic border is so nearly complete, that, if a geologist were making the circuit of the plateau province, he could so shape his route that for three-fourths of the way he would be treading upon eruptive materials, and pitch his camp upon them every night.

The classic group of laccolites known as the Henry Mountains is situated in the northern plateaus, and it is now known that this highly interesting type of eruption has been repeated at various points in the province. But perhaps no geological feature of the plateaus is of greater interest in connection with this monograph than the 'swells,' of which the San Rafael 'Swell' is the type; for the Zuñi Plateau is a noble example of this structure. There is a considerable number of swells in the plateaus, and they are of great importance by reason of their association with the most impressive features of the region. They are the localities of maximum erosion, — the centres from which the dissolution of the strata, through the wasting of their edges, has proceeded outwards, in ever-expanding circles, one bed or formation following another, until thousands of feet in thickness, and thousands of square miles in area, have been swept away. Along with this denudation has occurred a doming-up of the strata into a broad, gently swelling boss.

Captain Dutton's beautiful colored map, and the accompanying sections, bring out the topographic and geologic features of the region to which this monograph especially relates with wonderful distinctness. They show that the Zuñi Plateau is simply a great swell in a vast regional expanse of mesozoic rocks, breaking for a brief space the continuity of that system of strata, and presenting a well-marked monocline on either flank, a long, gentle slope of the strata on the north-east, and a short, abrupt slope on the south-west. From its broad surface the mesozoic has been denuded, leaving the edges of the strata, more or less upturned, to face it round about on all sides in rainbow cliffs. Away from the plateau the strata resume their normal horizontality, and the cretaceous becomes again everywhere the surface of the land. Vast and imposing is the expanse of this mighty cretaceous system. If we could rise in a captive balloon two thousand feet above the Zuñi Plateau, the radius of vision would embrace more than twenty thousand square miles covered with it. Yet this is but a trifle in comparison with its whole extent, which embraces half of the North American continent. Its thickness is equally matter of wonder. Whence came this stupendous mass of material? This is undoubtedly one of the most important and difficult questions in American geology.

North-east of the Zuñi Plateau, beyond the noble valley of the San José, rises Mount Taylor. It is a large volcanic cone planted upon a lofty and very extensive mesa of cretaceous strata heavily sheeted over with lava, the lava-cap being seldom less than three hundred feet thick. The cone occupies but a small part of the high platform on which it stands. It is merely the focus and culminating point of a rather large field of volcanic action. It is also clear that the immense cap of lava did not all come from this main orifice, but that the greater part was disgorged from numberless vents scattered over its entire surface, both the concentrated and the diffuse types of volcanic action being well exhibited in the same tract.

The great mesa on which Mount Taylor stands is only one of a series, and it forms only a small part of a great volcanic field. From its southern and eastern margins other mesas of similar composition are plainly visible; and it is certain that the sheet of lava once extended, perhaps without a break, across the broad intervening valleys of erosion, for they are now thickly studded with volcanic necks. These necks are ancient vents which have been exposed and left in striking relief by the wearing-away of the softer cretaceous strata over which their flows once spread. They form one of the most interesting and instructive features of the region, and Captain Dutton has described and illustrated them in considerable detail. It is impossible to follow him further in these interest-

ing descriptive chapters; but we must pass on to the general conclusions.

In the stratigraphy of the plateau country there is no fact of greater importance than the general if not complete absence of Devonian and Silurian strata below the carboniferous. In the Grand Cañon of the Colorado the carboniferous beds rest directly and conformably upon the Cambrian; and in the Zuñi Plateau the Cambrian is also wanting, and they repose upon the Archæan. But, although we thus have evidence of considerable areas of dry land in the Far West before carboniferous time, the strata of the latter age present, except where interrupted by subsequent erosion, one almost universal sheet of marine sediments over the whole western country.

The whole tenor of the evidence accords well with the inference that the surface of the plateau country during the Jura-Trias coincided very nearly with sea-level, but was continually oscillating from a little above to a little below that level, and *vice versa*. This is proved by the character of the sediments and the numerous unconformities by erosion, only without any discordance of dip. At one time it was a land area, sustaining a great forest vegetation, through which many species of dinosaurs wandered; at another it was overflowed by the ocean, and received deposits of fine sand, clay, and gypsum. Whatever may be the true explanation, it is a most extraordinary fact that three thousand to four thousand feet of strata were accumulated upon an area of over ninety thousand square miles, and yet the surface of deposition was maintained throughout at approximately the same level.

Very similar considerations are presented by the cretaceous system. As in the Jura-Trias, there were alternations of land and sea; and whenever the sea withdrew, the land thus laid bare bloomed with forests and swarmed with dinosaurs. Here we find, for the first time in the West, conditions favorable for the formation of coal. From top to bottom the shaly beds of the cretaceous include coal-seams and carbonaceous layers, while the intervening beds abound in fossil leaves. The carboniferous age of the Appalachians repeated itself here in the closing stages of the mesozoic, and upon a scale of equal if not greater grandeur.

An interesting question arises here. How does it happen that coal did not form in the Western Trias also? That vegetation was exuberant in that age is fully attested by the enormous abundance of fossil plants, which are usually silicified. The problem still awaits solution, but certain it is that the Jura-Trias has never yielded in the West a trace of carbonaceous matter. Its trees and shrubs have turned into stone instead of coal.

The source of the detritus forming the mesozoic strata of the West is found chiefly in the Great Basin of Utah, Nevada, etc. The fact is general that these strata grow thinner from west to east, indicating a western origin for its sediments. But the stupendous volume of the sediments in the United States and British America also indicates that they came from a source which was much more extensive than any island; in short, from some continental area, including the Great Basin, and having a shore-line many hundreds of miles long, with numerous large rivers discharging sand and silt.

The movements which ultimately isolated the plateau province, and gave it its distinctive history and development, began in the Laramie period; and during eocene time its area was a vast inland lake with an outlet. In this lake eocene sediments were deposited to a maximum thickness of five thousand feet toward the north, and thinning southward, indicating that they were derived mainly from the Rocky, Uinta, and Wasatch ranges, which were then in existence. The plateau lake finally disappeared in the miocene period, and thus closed the long period of almost continuous deposition which began in early carboniferous time, and during which from ten thousand to fifteen thousand feet of sediments were accumulated.

All this region proclaims an ancient erosion far more vigorous than the present. This is seen in the wide, eroded valleys, fit for the passage of great rivers, but vacant now of flowing waters, their troughs half filled with alluvium, and the grass growing over their flood-plains. We are obliged to refer this erosion to the miocene, and the great elevation of the country which followed it probably occurred during the pliocene.

The elevation of the Zuñi Plateau was attended by the marked bulging or protrusion of limited portions of the Archæan mass carrying up with them the overlying sediments, and forming Mount Sedgwick and other elevations borne upon the plateau. The forms of these granite bosses, as well as the remarkable metamorphism of the immediately overlying carboniferous sandstone, would seem to suggest very strongly that they may be true laccolites. And this view relieves us of the necessity of accounting for the softening *in situ* of the Archæan so near the surface, since these bosses can never have been covered by more than ten thousand feet of strata. There is evidence that the basic eruptions which built up Mount Taylor and the volcanic caps of the mesas were subsequent to some part of the principal erosion of the country, though contemporaneous with a large part of it.

None of Captain Dutton's conclusions will interest the general student more than those relating to the formation of mountains. He traces a series of mountain forms from the extreme simplicity of structure disclosed in the Zuñi Plateau to the comparatively complex structure of the Wasatch and Basin ranges, and finds a generic idea running through them all. It is the idea that was taught us when we were school-boys, that mountains consist of granitic or metamorphic cores, with sedimentary strata upturned upon their flanks.

"Within the past twelve or fifteen years it has become a widely accepted view among the geologists of Europe and America that the forces which have elevated mountains are derived from the strains set up in the outer envelopes of the earth by the secular cooling and shrinkage of its interior; but it should be borne in mind that geological science has flourished most in those countries where the best known and most thoroughly studied mountains and ridges are greatly plicated. To the European geologist the Alps and the Jura have always been the most commanding and interesting of orographic structures. To the Briton the highlands of Scotland and Wales have been equally absorbing fields of research, in which the solution of the problem of mountain-building has been attempted. In America geology had its first and most rapid growth in the Appalachian region, and, when it sought fresh fields in the Pacific slope, it first found them in the Coast Ranges and in the Sierra Nevada. All of these regions are more or less plicated; and it is not to be wondered at that a universal conviction should have grown up that plication and mountain-building are only different names for one and the same thing, or that the process which built the mountains folded the strata at the same time. But as soon as the geologists penetrated the vast mountain-belt which lies east of the Sierra and west of the Great Plains, and proceeded to a careful study of the forms there presented, a wholly different state of affairs was revealed. Not a trace of a systematic plication has yet been found there. The terms 'anticlinal' and 'synclinal' have almost dropped out of the vocabulary of the Western geologist. The strata are often flexed, but the type of the flexure is the monocline."

"The Rocky Mountain region discloses whatever it has to tell us about physical geology with marvellous clearness and emphasis, but there is no teaching more clear or more emphatic than the absence of plicating forces from among the agencies which have built its magnificent ranges and hoisted its great plateaus. They have been lifted by vertical forces acting beneath them. The country at large shows no traces of a widespread, universal, horizontal compression; on the contrary, it discloses the absence of such stress."

These statements are undoubtedly correct, so far as the paleozoic and later formations, and the existing reliefs of the West, are concerned; and Captain Dutton probably did not intend that they should be applied to the Archæan strata of that region, since these are everywhere as strongly plicated as the rocks of any district on the globe. When these ancient crystalline schists of the Rocky Mountain region were folded up, mountains of the Appalachian type must have been formed. But these were largely swept away by erosion before the beginning of the grand cycle of events which Captain Dutton has outlined.

NOTES AND NEWS.

AT a meeting of the Biological Society of Washington, Dec. 17, an interesting paper was read by Mr. C. L. Hopkins on the sense of

smell in buzzards. This much-debated point was strongly set forth by Mr. Hopkins relating his experience in Florida. It was the uniform testimony of the Florida 'crackers' that buzzards obtained food by smell. He observed that buzzards never left their roosts on damp, foggy mornings until the ground and shrubbery were dry. They would then move slowly across the wind until a scent was struck, when they would work up the wind until the carrion was found. Sometimes they would drift down the wind, past their prey, until they struck the scent, which would be followed up, finding the object of their search sometimes in the densest scrub. He had on several occasions killed wild hogs in the scrub, and after dressing them, and taking what meat he wished, would see twenty or more buzzards coming down with the wind. On several occasions, covered offal had been detected by them. They had also discovered a buried snake. Several other instances were related, which, in Mr. Hopkins's opinion, conclusively proved that buzzards find some of their food by scent, though that did not preclude the possibility or probability that they obtain other food by sight.

—An interesting event took place at the Perkins Institute for the Blind at South Boston on Dec. 21. It was the celebration of the fiftieth anniversary of the entrance into that institution of Laura Bridgeman, the famous blind deaf-mute. Her first instructor, Dr. Samuel G. Howe, is long since dead; but his wife, Mrs. Julia Ward Howe, presided at the reception. The phenomenal education of Miss Bridgeman will always remain a monument of pedagogic skill. She lost her sight and hearing when two years old, and her taste and smell are both very defective. She speaks by making the manual signs of the deaf-and-dumb, and reads the similar motions of the 'speaker' by feeling the letters as they are formed. She does this with marvellous rapidity, and all the addresses were interpreted to her as they were delivered at the reception. Among the speakers were Dr. Edward Everett Hale and Dr. Phillips Brooks.

—The only railway extending into the Arctic zone runs north from the port of Lulea, in Sweden, at the head of the Gulf of Bothnia, toward the iron-mines of the Gellivara Mountains. The first train to cross the Arctic circle passed over this road a few weeks ago.

—Mr. J. A. Brashear gave an exhibition at his works, Allegheny, Penn., on Dec. 8, 9, and 10, of the large star spectroscope designed and constructed for the Lick Observatory, Mount Hamilton, California.

—The secretary of the committee for the organization of the American Folk-Lore Society, W. W. Newell, Cambridge, Mass., announces that the society will organize in a meeting to be held on Jan. 4 in Cambridge, Mass. The number of members amounts at the present time to two hundred, and, as the society has thus obtained an income sufficient to support a journal, it will begin work. The plan of organizing a society of this kind must recommend itself to all interested in the science of man. The scope of the society's work will be the study of the relics of Old English folk-lore, the lore of negroes in the Southern States of the Union, lore of the Indian tribes of North America, and that of French Canada, Mexico, etc. Furthermore, the study of the general problems of folk-lore, and publication of the results of special students in this department, will form one of the objects of the society. Our country is particularly adapted to the study of certain problems connected with folk-lore, such as the development of European and African lore in a new environment, and the origin of a new lore in mixed races. The material furnished by such researches is of prime importance for a study of the psychology of nations. It is hardly necessary to emphasize the fact that the collection of the rapidly vanishing remains of Indian folk-lore must be carried on vigorously, and on an intelligent plan, else it will be too late. The publications of the society will undoubtedly contain a vast amount of interesting material, and will amply repay the annual fee of three dollars. Our knowledge of the subject of American lore is still so slight, that almost any one who comes into contact with Indians, negroes, or the less educated white men, can make valuable contributions to this science; and therefore we would wish that the membership of the new society were thousands instead of hundreds.

— An interesting geographic sketch lies before us, which refers to a country but seldom described. It is Charles Bell's 'The Selkirk Settlement and the Settlers' (Winnipeg, 1887, 44 pp.), its contents being a concise history of the Red River Country of Canada from its discovery. It is also made to include local information from original documents lately discovered, and many biographical notes from old Selkirk colonists. A considerable portion of the pamphlet is taken up by the narration of the Selkirk colony's foundation under the leadership of Miles MacDonell, born in Inverness, Scotland, in 1769, and selected by Lord Selkirk in 1810 for the purpose above mentioned. The colonists started from Stornoway to the number of one hundred and twenty-five, and consisted of Londoners, Scotchmen, Irishmen, and inhabitants of the Orkney Islands. The party did not arrive at Red River, Manitoba, before August, 1812, and then set themselves to erect buildings on the west bank of Assiniboine River. The colony already exceeded the number of two hundred colonists, when in 1814 trouble arose with the employees of the North-west Company. Several bloody conflicts took place before tranquillity was restored, four years after. Numerous woodcuts contribute largely in enlivening our interest in the narrative presented by Mr. Bell.

— The explosion of a water-reservoir or boiler in the kitchen of the Kirby House, Milwaukee, recently was perfectly recorded in the vibrations given by the shock to a ruling-machine in the bindery of *The Sentinel*. The machine is directly opposite one of the windows of the bindery, and was in full motion when the explosion took place, drawing straight lines. The first impulse of the shock carried the pen nearly half an inch from the true line; then for some distance it approached the true line again without wavering, when it suddenly drew waving lines for the final reactionary vibrations. The lines are just such as are made by the seismometer in an earthquake shock.

— Recent soundings in Lake Lemman and the Lake of Constance have shown that the beds of the Rhone and of the Rhine may be traced for a considerable distance on the bottom of the lakes. It is well known that the deposits of these rivers form a flat cone extending far into the lakes. On these cones embankments are found which enclose the bed of the river. That of the Rhine is cut into the deposits, while that of the Rhone is not deeper than the surface of the cone. F. A. Forel has studied these phenomena thoroughly. He determined the density of the water of the Rhone and of Lake Lemman, and found that the former is almost throughout the year denser than the latter. A series of experiments on the influence of suspended matter upon the density of water shows, that, if the matter is moving vertically downward, the density of the mixture may be found by adding the weight of the suspended matter to that of the liquid, and dividing the total by the volume of the mixture. As the Rhone carries a great amount of suspended matter, the latter must be taken into consideration; and Forel's researches show that the density of the water of the Rhone, as dependent on its temperature and the amount of dissolved and suspended matter, is greater than that of the lake except during a brief period in spring. On the sides of the current, where it adjoins the stagnant water of the lake, the suspended matter is precipitated, and thus the dikes are formed. It is possible, that, in addition to this, the water of the rivers has a slight eroding action.

— On Dec. 1, Sir John Lubbock, we learn from *Nature*, read a paper before the Linnean Society, in continuation of his previous memoirs, on the habits of ants, bees, and wasps. He said it was generally stated that the English slave-making ant (*Formica sanguinea*), far from being entirely dependent on slaves, as was the case with *Polyergus rufescens*, the slave-making ant *par excellence*, was really able to live alone, and that the slaves were only, so to say, a luxury. Some of his observations appeared to throw doubt on this. In one of his nests the ants were prevented from making any fresh capture of slaves. Under these circumstances, the number of slaves gradually diminished, and at length the last died. At that time there were some fifty of the mistresses still remaining. These, however, rapidly died off, until at the end of June, 1886, there were only six remaining. He then placed near the door of the nest some pupæ of *Formica fusca*, the slave ant. These were at once carried in, and soon came to maturity. The mortality

among the mistresses at once ceased, and from that day to this only two more have died. This seems to show that the slaves perform some indispensable function in the nest, though what that is still remains to be discovered. As regards the longevity of ants, he said that the old queen ant, which had more than once been mentioned to the society, was still alive. She must now be fourteen years old, and still laid fertile eggs, to the important physiological bearing of which fact he called special attention. He discussed the observations and remarks of Graber as regards the senses of ants, with special reference to their sensibility towards the ultra-violet rays, and referred to the observations of Forel, which confirmed those he had previously laid before the society. Professor Graber had also questioned some experiments with reference to smell. He, however, maintained the accuracy of his observations, and pointed out that Graber had overlooked some of the precautions which he had taken: his experiments seemed to leave no doubt as to the existence of a delicate sense of smell among ants. As regards the recognition of friends, he repeated some previous experiments, with the same results. He took some pupæ from one of his nests (A), and placed these under charge of some ants from another nest (B) of the same species. After they had come to maturity, he placed some in nest A, and some in nest B. Those placed in their own nest were received amicably; those in the nests of their nurses were attacked and driven out. This showed that the recognition is not by the means of a sign or password, for in that case they would have been recognized in nest B, and not in nest A. Dr. Warsmann had confirmed his observations in opposition to the statement of Lespis, that white ants are enemies to those of another nest, even belonging to the same species: the domestic animals, on the other hand, can be transferred from one nest to another, and will be amicably received. In conclusion, he discussed the respective functions of the eyes and ocelli, and referred to several other observations on various interesting points in the economy of the social *Hymenoptera*.

— The reports of the German factory inspectors for 1886 contain some interesting statistics respecting the hours of labor, accidents, etc., in various districts and in different employments. On the whole, the number of work-people increased, in the fifteen districts for which reports are published, from 596,561 in 1884, to 642,386, being an increase of 33,496, or 7.7 per cent, of males, and 12,329, or 7.6 per cent, of females. The industries in which the chief increase took place were textiles, food, wood, and carving. There was a great decrease in the number employed in mining. In some districts there was a great lack of employment, while farmers were complaining that they could not find laborers to do their work. In Bavaria, in 29.4 per cent of all industries the hours of labor were from 11½ to 16 hours daily; in 59.6 per cent from 10 to 11 hours; and in the remainder from 11 down to 5 hours. The last-named time applied only to the work of putting the quicksilver on the backs of looking-glasses. Excessively long hours prevail in breweries, where they are never less than 16 hours a day. In the Düsseldorf district nearly 40 manufacturers of textiles have entered into a convention not to make the working-day longer than 12 hours. According to a regulation made in 1885, all accidents in factories must be brought to the knowledge of the inspectors. This accounts for the apparently enormous increase in the number of accidents: 2,394 were brought to the inspectors' notice during the year. These are arranged under two heads: (1) The causes; (2) The consequences to the victim. More than one-half are put down to inevitable accident, and more than one-third to carelessness and want of skill. More than four-fifths were attended only with temporary incapacity for work. The work-people appear to understand and enter into the spirit of the recent insurance laws; but it seems from the reports that the increase of children's labor, the night-work of women, and the prolonged hours of labor of women and children in certain places, are the next subjects connected with German labor that call for legislative regulation and interference.

— The attempt is being made to organize a debating club in the American Geographical Society for the purpose of discussing geographical questions and results of new investigations. It is hoped that all cultivators of geophysics, geography, commercial geography, and allied sciences, as well as teachers of geography and those interested in its study, will join the club. All intending to become

members of the club will please send their names and addresses to Dr. F. Boas, 47 Lafayette Place, New York.

— Mr. Montagu Kerr has left for Zanzibar to undertake a journey of some venture across Africa. Mr. Kerr has already done good work in Africa, in the journey which he made, almost single-handed, from the Cape to the Zambesi and Lake Nyassa, partly through new country and among some very troublesome tribes, whom he managed with great tact. In his present expedition, which he undertakes entirely at his own charge, Mr. Kerr means to proceed through Massai-land to the north end of Victoria Nyanza, and thence to Emin Pacha's station at Wadelai. His further course will be to some extent guided by Emin Pacha's advice; but his present intention is to proceed westwards to the Lake Chad region, where he hopes to do some good exploring work, and then, if possible, go on to the Niger and descend that river. Mr. Kerr has a strong letter of recommendation from the Marquis of Salisbury to the British consul at Zanzibar. It is possible that when he reaches Zanzibar Mr. Kerr may meet Mr. Stanley, or at least hear of the results of his mission, and may thus be led somewhat to modify his plans. But whatever course he may take, if he keeps his health, he is pretty sure to do some good work. He has, since his return from his last expedition, done every thing possible to qualify himself for scientific observation, and is quite prepared to pass muster as a Mohammedan in the most fanatical Moslem districts. Mr. Kerr is furnished with a set of instruments by the Royal Geographical Society. All who know him have confidence in his pluck and discretion.

— In the October *Monthly Weather Review*, the long drought of 1887 is discussed. During the six months from May to October inclusive, the rainfall has been largely deficient over the district between Dakota, Michigan, Kentucky, and Kansas. Less than one-half the usual amount of rainfall during these months has fallen in central Ohio. Less than three-fourths of the average amount of rain has fallen during these few months from Michigan, Ohio, and Kentucky westward, to include Missouri and Iowa. Of special interest is a compilation of excessive rainfalls in the month of October for a series of from ten to sixteen years. In a letter to the *Engineering News*, General Greely says, "It is the intention of this office to continue this discussion by months. A systematic effort has been made to make the data for succeeding months more complete and full than for October. In addition, the chief signal-officer has issued instructions to the observers, calling their especial attention to heavy rainfalls." The *Engineering News*, in an editorial, had emphasized the importance of measurements of heavy rainfalls; and in reply to this the chief signal-officer writes, that if the engineers of the country are in earnest about this matter, and will persuade Congress to appropriate twenty-five hundred or three thousand dollars for the purpose of buying self-registering rain-gauges, efforts will be made to spend the money economically, and to distribute the gauges so as to completely cover the country. It is very desirable that the plan should be carried out, as these observations, in connection with the gauge measurements published in the reports of the chief of engineers, would be highly valuable from a scientific as well as from a practical point of view, as the interval between excessive rainfalls and floods and the influence of the character of the rainfall upon that of the flood is of eminent importance for the low parts of the country and for the construction of roads, canals, and other works.

— The first number of *The American Geologist* has just been issued. It is stated in the prospectus that the journal will be devoted to geology in its widest sense, and to allied sciences in all those directions where their special investigations bear directly upon the constitution and history of the globe. A journal of this character will be highly welcomed by all interested in the subject; and, as the amount of geological work done in North America is very great, it will undoubtedly flourish, and become indispensable to students of American geology. The continuous increase in the number of journals devoted to special sciences is highly gratifying, as it is proof of a rapid progress of science, and as it prevents the scattering of investigations in one branch of science through numerous journals. The editors are Prof. S. Calvin, T. W. Claypole, Dr. Persifor Frazer, Dr. L. E. Hicks, E. O. Ulrich, Dr. A. Winchell, and

Prof. N. H. Winchell. It is published in Minneapolis. The first number contains interesting communications on the International Congress of Geologists, on geological problems and observations in Minnesota and Iowa, editorial comments, and a review of recent literature.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith. Twenty copies of the number containing his communication will be furnished free to any correspondent on request. The editor will be glad to publish any queries consonant with the character of the journal.*

The Mechanism of the Flight of Birds.

THE subject of the interesting letter by my friend Prof. J. S. Newberry in a late number of *Science* is an extremely important one, which has lately been discussed before the National Academy of Sciences and the Linnæan Society of New York, by Professor Newberry, Professor Trowbridge, and others. Much as I regret my absence on those occasions, I am still more sorry to be obliged to dissent without qualification from the position taken by these gentlemen, which is, to my knowledge, quite untenable. Since the matter has been published, I crave permission to state the facts in the case, and incidentally to present the very curious history of the discovery of the remarkable mechanism of flexion and extension in birds' wings, involving what I would call the 'precession and recession of the radius along the ulna.'

First, With regard to the alleged locking of the primaries: 1. It does not take place; 2. Did it take place, flight would be impossible.

Second, Extension of the carpo-metacarpus upon the ante-brachium is automatically effected whenever the antebrachium is extended upon the brachium; and, conversely, flexion of the carpo-metacarpus upon the antebrachium is automatically effected whenever the antebrachium is flexed upon the brachium. In other words, the elbow and wrist of a bird work together, and neither can be bent or straightened to any considerable extent without the other being also bent or straightened. This motion, be it observed, in the cubito-carpal joint, is not flexion and extension in the usual technical sense of those terms, but is the movement commonly called, as in human anatomy, adduction and abduction. Moreover, the peculiar movement of the cubital bones (radius and ulna) which produces pronation and supination (as in man and many other mammals which use their fore-paws as hands) is reduced to a minimum, if not absolutely *nil*, in a bird's wing. It is just these points: (a) substitution of adduction and abduction for flexion and extension; (b) substitution of the lengthwise sliding back and forth of the radius along the ulna, or recession and procession, for that rolling sidewise of the radius upon the ulna which is pronation and supination; and (c) the reciprocal interaction of the elbow and wrist-joint, — it is just these points, I aver, which are the gist of the peculiar mechanism of birds' wings, so far as the bones themselves are concerned.

All these points are fully described, and illustrated by figures, in two of my works; namely, 'Proceedings of the American Association for the Advancement of Science, for 1871' (vol. xx., pub. 1872, pp. 278–284); and 'Key to North American Birds' (2d edition, 1884, pp. 106 seq.).

Third, The history of the case is curious, showing the quadrupled discovery of the precession and recession of the radius by four independent observers: (a) Bergmann (1839), (b) Wyman (1855), (c) Coues (1871), (d) Garrod (1875). To take these up in reverse order: —

(d) GARROD (A.H.), 'On a Point in the Mechanism of the Bird's Wing,' *Proceedings of the Zoölogical Society*, Feb. 16, 1875, pp. 82–84. [The gist of the paper is the peculiar sliding motion of the radius along the ulna. Garrod writes as an independent discoverer, as no doubt he was, or he would of course have referred to the previous writers.]

(c) COUES (E.), 'On the Mechanism of Flexion and Extension in Birds' Wings,' *Proceedings of the American Association for the Advancement of Science*, xx. for 1871, pub. 1872, pp. 278–284; abstract in *American Naturalist*, v. 1871, pp. 513, 514; reproduced in substance, *Key to North American Birds*, 1884, pp. 106 seq. [See text above. The writer, like Garrod, was ignorant when he made the discovery that any one had preceded him.]

(b) WYMAN (J.) [Remarks on a duck's wing, etc.] *Proceedings Boston Society of Natural History*, v. 1855, p. 169. [As I say in my 'Bibliography,' *Bull. U.S. Geogr. Surv. Terr.*, v. 1880, p. 952, this is a paper "showing mechanism of flexion and extension, contributing to fixity of the limb, independently of muscular action." Wyman evidently discovered it himself, and was ignorant of Bergmann's discovery.]

(a) BERGMANN (Dr. C.), 'Ueber die Bewegungen von Radius und Ulna am Vogelflügel,' Müller's *Archiv f. Anat. u. Phys.*, vi. 1839, pp. 296-300. [This is an important, interesting, and so far as I know a novel paper on the peculiar mechanism of the fore-arm of birds, before mentioned in none of the works of Meckel, Cuvier, Tudemann, Wagner, etc. The sum of his paper is, that sliding motion lengthwise of the bones, whereby extension of the fore-arm upon the arm, and flexion of the same, respectively reproduce the same movements at the wrist.]

The last four paragraphs are extracted from my 'Bibliography of Ornithology,' most of which is still unpublished.

It is fortunate that the mechanism of the wing does not permit the primaries to lock in the manner that has been supposed, for, if it did so, birds could not fly.

One point more, and I hasten to conclude remarks that I wish were not necessarily so ungracious. The 'fixing of the wing' of a mortally wounded bird, in the manner described by Professor Newberry, does not bear on the case. It is simply a muscular rigidity, due to nervous shock, and of a part with the convulsive muscular action which, under similar circumstances, results in the well-known 'towering' of hard-hit birds. ELLIOTT COUES.

Smithsonian Institution, Washington, Dec. 21.

THE recent discovery of the power possessed by soaring birds to set their wings when fully expanded, and to remain locked independent of muscular action, explains to my mind a phenomenon that has puzzled me for many years. It has been my custom for many seasons to spend a few days each fall duck-shooting at the lakes bordering the Illinois River in central Illinois. The birds were almost invariably shot in mid-air, while flying rapidly by, and often, when not killed at once, they would set their wings and sail gradually down to the water or ground, which they would reach dead, the distance being from one hundred yards to a quarter of a mile, apparently corresponding to the height of the bird when shot. And it was a maxim with duck-shooters on these lakes, "That bird is killed, for he has set his wings."

Besides the ducks, I have seen this phenomenon illustrated in the wild turkey and prairie-hen. In wing-shooting the wild turkey, if it set its wings, and gradually came to the earth a quarter of a mile or more away, we always marked the spot, well expecting to find the dead body when we reached it. With Mr. J. S. Newberry, I trust that some student of anatomy will take up this subject, and demonstrate it to a certainty. W. S. STRODE, M.D.

Bernadotte, Ill., Dec. 22.

Eskimo and Indian.

CONSIDERING the intimate knowledge of the Eskimo language possessed by the two gentlemen who have passed their criticisms upon my remarks on the subject of the past relations of the Eskimo and the Indian, it would be of little avail for me to enter into any lengthy argument upon the matter, although I still consider that there is room for difference on many of the points raised. On a later occasion, I intend elsewhere to treat the subject, both in its ethnographic and philological aspects, on somewhat broader lines than in the article referred to. The evidence in favor of some relation in the past between the Eskimo and the Iroquois seems to me to be convincing, aside altogether from philological data. Kohlmeister and Kmoch (p. 37) state that there is a legend among the Eskimo that the "Greenlanders originally came from Canada, and settled on the outermost islands of the coast, but never penetrated into the country before they were driven eastward to Greenland." Dr. Brinton (in his *Myths of the New World*, p. 24, note) says, "It is curious that the traditions of the *Tuscaroras*, who placed their arrival on the Virginian coast at about 1300, spoke of the race they found there (called *Tacci* or *Dogi*) as eaters of raw flesh, and ignorant of maize." Dr. Rink (*Tales and Traditions of the*

Eskimo, p. 11) has the following interesting passage *in rem*: "In the most remote ages the Eskimo, on their trading expeditions, appear to have overpassed their present southern limits. This may be gathered partly from *pure Eskimo words* being found in the language of more southern tribes, partly from the sagas of the old Scandinavians, who seem to have met travelling Eskimo, even to the south of Newfoundland." With regard to the general subject, M. Petitot ('De la prétendue origine orientale des Algonquins,' *Bull. Soc. d'Anthrop. de Paris*, vii. p. 248) expresses himself thus: "Ce qui est bien certain c'est que les *Inini* ne sont pas sans posséder de nombreux rapports de mœurs, de coutumes, de physionomie, de traditions, et même de langue avec leurs voisins les *Pieds-Noirs* les *Tetes-Plates*, et même avec les *Esquimaux*." Elsewhere the same writer observes, "Il n'ai pu trouver dans l'esquimaux du Mackenzie un seul mot qui provint de l'idiome *dend-dindjé*. Il aura plus de corrélation grammaticale avec le *cris*, dialecte algonquin . . . si dans cette langue les pronoms ne précédaient aussi la racine verbal comme en *dend*, au lieu de la suivre. La consonnance des mots y est à peu près la même. Dans les deux langues on remarque quantité de mots commençant par une voyelle et terminés en *ak, ik, ok, in, it*" (*Vocab. Français-Esquimaux*, Introd. p. v.). This, to be sure, may not be strong evidence, but it points in a certain direction. From a comparative study of the Eskimo and Iroquois-Algonquin languages, it is certain there is much to be learned. If I have not succeeded in proving, from philological evidence, relations in the past between these people, I can only wait until others shall have done so. Mr. Murdoch has referred to the lack of phonetic vocabularies, and the errors consequent upon the use of such as are at present available. Surely, all the blame cannot be laid upon investigators, who endeavor to do good work with poor material. A glance at the 'Eskimo Bibliography,' lately compiled by Mr. Pilling, is sufficient to convince one that a very great portion of Eskimo linguistic material (and presumably the most valuable, because the most recent and scientific) is still in manuscript in the Library of the Bureau of Ethnology and other great institutions. When this shall have been published, and so distributed throughout the continent, so as to insure facility of access to students, then, I trust, the evidence of past relations between the Eskimo and Indian will be forthcoming, and the fact of their occurrence be capable of proof on scientific grounds. Elsewhere I have discussed the broad question of the pre-history of the Eskimo race, judging them to have been the dolichocephalic people who formerly extended over a great portion of the North American and perhaps of the South American continent. They have been intruded upon and pushed back by more warlike and aggressive races. Not a little interesting is the remarkable correspondence of the Botocudos and other South American tribes in many respects to the Eskimo; and the same remarks apply to some of the so-called 'fossil-men' of Brazil.

A. F. CHAMBERLAIN.

Toronto, Dec. 17.

Weather-Predictions.

PERHAPS it can hardly be said that there is a science of weather-prediction at the present time; yet interest in the subject is increasing, and there are several persons in this country who are issuing daily scientific forecasts. While the basis upon which forecasts shall be issued admits of little discussion, yet it is far otherwise with their verification, and it would seem that much confusion has arisen on this account. The following comparison of weather-forecasts is given with the hope that others will enter the field outlined, and that a general discussion may clear up some of the misty points. The forecasts were made during October for Boston, Mass., by Mr. Clayton at Blue Hill, and by the writer at Washington, D.C. The predictions were for 'fair,' 'rain,' and halfway between, or 'threatening.'

The verifications were to be by the observations at Boston, made at 7 A.M., 3 and 10 P.M., each day. As there was no specific record of 'threatening,' the amount of clouds was to determine this condition. The prediction was made at Blue Hill at 2 P.M. each day from an examination of the Signal Service observations made over the country at 7 A.M., together with a study of the local conditions at 2 P.M. The Washington prediction was necessarily made from the 7 A.M. observation alone. The interval predicted for was from

midnight of each day to the succeeding midnight. The following table exhibits each prediction and the weather that followed:—

Prediction.		Weather.				Prediction.		Weather.			
(1)	(2)	7	3	10	rain	(1)	(2)	7	3	10	rain
rain	rain	cloudy	cloudy	clear	.05	fair	fair	clear	clear	clear	0
rain	rain	fog	clear	cloudy	.02	fair	threat.	fair	cloudy	cloudy	.01
rain	threat.	cloudy	fair	clear	0	fair	threat.	cloudy	clear	clear	0
fair	threat.	clear	fair	cloudy	0	rain	fair	clear	cloudy	cloudy	0
fair	threat.	clear	fair	fair	0	rain	rain	lt. rain	cloudy	cloudy	.96
fair	fair	clear	fair	fair	0	fair	fair	clear	cloudy	cloudy	0
fair	fair	cloudy	cloudy	cloudy	0	fair	fair	clear	fair	clear	0
rain	rain	lt. rain	cloudy	cloudy	.76	fair	fair	cloudy	cloudy	cloudy	0
fair	fair	fair	fair	clear	0	rain	threat.	clear	clear	cloudy	0
fair	fair	fair	cloudy	clear	0	fair	fair	fair	cloudy	cloudy	0
fair	fair	clear	cloudy	clear	0	th.	fair	cloudy	cloudy	fair	0
fair	fair	clear	clear	clear	0	rain	threat.	cloudy	clear	fair	0
						th.	fair	fair	cloudy	fair	0

It will be seen that the prediction was the same in fifteen cases, and eleven of these were fully verified. In order to obtain a fair comparative estimate for the remaining ten days, the predictions and the succeeding weather were referred to Prof. I. Russell, who decided that No. (1) agreed better with the weather twice, and No. (2) eight times. If these ten be regarded half verified, we shall obtain for No. (1) 48 per cent and No. (2) 60 per cent.

The predictions were also referred to Professor Upton, who suggested two schemes for verification, by one of which he computed No. (1) 67.2 per cent, and No. (2) 69.6 per cent; and by the other, No. (1) had 61.0 per cent, and No. (2) 65.0 per cent. As Professor Upton preferred the second scheme, I give it in detail. His plan was as follows:—

Arrange all possible weather-combinations in a table, and give to each prediction a certain weight according to its position in the table, as follows:—

Weather.			Predictions.		
			fair	threatening	ra
clear	clear	clear	3	0	0
clear	clear	fair	4	1	0
clear	fair	fair	4	1	0
fair	fair	fair	4	1	0
clear	clear	cloudy	3	2	0
clear	fair	cloudy	3	2	0
fair	fair	cloudy	3	2	0
clear	cloudy	cloudy	2	3	1
fair	cloudy	cloudy	2	3	1
cloudy	cloudy	cloudy	1	4	2
trace	of	rain	0	3	3
	rain		0	2	4

In this scheme it is possible that too much weight has been given 'fair,' and too little 'threat.' However, as the prediction 'threat,' seems of doubtful utility, it should have less weight.

This discussion has brought out one fact of great interest regarding methods of verification. Mr. Clayton verified the same predictions by the observations at Blue Hill, a station very near Boston. He makes the percentage 85. This great difference of 24 per cent seems very surprising, and can hardly be due to the difference in weather at the two places. It seems probable that this difference is due to the method of verification, and that a mere percentage obtained from an arbitrary verification cannot be relied on for com-

paring the relative merits of two predictions. It is to be hoped that a further discussion of this question may lead to clearer light and understanding of the methods of prediction and verification best suited to the needs of the public.

H. A. HAZEN.

Washington, D.C., Dec. 14.

The Chinese Wall.

THE note on the Chinese wall in a late issue of *Science* (x. No. 253), calling attention to Abbé Larrieu's assertion that the wall does not exist, recalled to mind Abbé Huc's account. Turning to it, I find that he was a believer in it, and with good reason. In Vol. II. of his 'Journey through Tartary, Thibet, and China,' p. 31, he gives the following account, which may interest some of your readers, and serve to correct an erroneous impression:—

"The part of the wall immediately to the north of Pekin . . . is really fine and imposing; but it must not be supposed that this barrier is equally large and solid throughout its whole extent. We have had occasion to cross it at more than fifteen different points, and have often travelled for days together without ever losing sight of it; and instead of the double battlemented stone wall which is seen at Pekin, it is sometimes a very humble-looking wall of clay; and we have even seen it reduced to its simplest expression, and composed only of stones piled up together."

Thus, though the wall may not and does not have the magnitude and solidity often attributed to it, yet in one form or another it certainly seems to exist, and is not, as we are told Abbé Larrieu says, 'a huge Chinese lie.'

JOSEPH F. JAMES.

Miami Univ., Oxford, O., Dec. 20.

Tornado Force.

I SEND you some facts in relation to tornado force and its peculiarities of action, which may not be uninteresting to your readers, on either side of the question, involving the nature of the force or forces.

The tracks examined by me did not present continuous lines of destruction, but areas of destruction separated by intervals entirely or almost entirely exempt from destructive forces, from which it is inferred, that while the storm, in its common and ordinary features, pursued its way steadily onward by bodily transference, the tornadic action was developed interruptedly, and progressed by successive transplantings.

The first area examined, tornado of April 23, 1883, was composed of two distinct parts. The first was a long rectangular space of about half a mile in length, from west-south-west to east-north-east, and a hundred and fifty to two hundred yards in width. Within this space the trees were prostrated from south-east, south, south-west, and west, and intermediate points; and, wherever two or more were found lying across each other, the one thrown from the direction nearest to east, or farthest round from west, was always at the bottom. Thus, those thrown from south always lay on top of those from south-west, those from south-west on top of those from south and south-east, and those from west were always on top of all other directions. This order was without an exception. The rectangular area terminated at the east end in an irregularly circular area of about eight hundred yards diameter, either east and west or north and south. Bisecting this area both ways, and dividing it into four quadrants, the south-west and south-east were found to correspond in all respects with the rectangular area, except that in the south-east there was a greater proportion of trees thrown down from east-south-east and south-east than in the other sections; and in the south-west quadrant, near the centre, a tree thrown from south-west was overlain by one from south, the single exception to the order noted above. In the north-east quadrant the destruction was less than in either of the others, and trees were thrown down from east, north-east, north, north-west, and west. In the north-west quadrant the trees were thrown from north, north-west, and west, chiefly from north-west, west-north-west, and west; and in the instances where they crossed each other, the order in relation to the west was similar precisely to that of the other parts, progressing from east round by north to west, as, on the other side, the progression was from east round by south to west; so that in these, the north-east and north-west quadrants, trees thrown from north-east lay under those from north, those from north under those from

north-west, while, as in the south quadrants and in the rectangular space, those from west were on top of all. The central line, west to east, through the circular area, corresponded very closely with the prolongation of a line running through the north border of the rectangular area. In the south-west quadrant a slim pine seventy to seventy-five feet high was left standing, surrounded by seven stumps or shafts varying in height from ten or fifteen to forty or more feet, and in distance from the standing tree, from five to twenty-five feet. Near the centre of the circular area two trees stood side by side, east and west of each other, and so near that their trunks at the bases could not have been more than a few inches apart, if they did not actually touch. The tree on the east side was thrown from west to east, and the other in the opposite direction, from east to west. Two pines fifty to sixty feet high and thirty to forty feet apart, one in the south-east, the other in the north-east quadrant, and about equidistant from the east and west central line dividing these quadrants, were thrown towards the central line, the one from north to south, the other from south to north (tornado of Dec. 22, 1884). They apparently fell simultaneously, and met in the fall; for their broken trunks and branches were mingled together in a confused heap, the branches of one tree undistinguishable from those of the other. The cabin of Isaac Johnson, a negro laborer, situated in the track, near the western end of the rectangular area, was partially unroofed and otherwise damaged. He stated that his table-ware—plates, spoons, knives and forks—went flying out of the door like so many birds; and after the storm he found his fanner securely poised on a stump, bottom upwards, about seventy yards from his cabin; and on the fanner lay his nutmeg-grater, as though placed there by hand (the fanner is a shallow, tray-like vessel made of straw). The trunks of some trees, pine and hickory, seemed to have been rent asunder, as by a splitting force acting within the trunks, and in these cases the upper segment was scarcely ever entirely separated from the stump; and from both stump and upper fragment, long, thin, lath-like splinters projected, some of them eight to ten feet in length, an inch or two in width, and a half to three-quarters of an inch in thickness. About half a mile to the east of the eastern terminus of this tornadic area, the second area of destruction began, and presented a rectangular area like the first, several hundred yards in length; but here the conformity with the first ended, the forces appearing to have become scattered. The circular area was undeveloped, the north-east and south-east quadrants being entirely wanting, and the north-west quadrant defective, in so far as the forces acting from north and north-west were concerned. The south-west quadrant presented patches of destruction here and there, with features similar to those of the like quadrant of the first area; and here, too, was a single exception to the order in which the forces everywhere else acted, namely, a tree thrown from south overlying one from south-west. The trees prostrated in the north-west quadrant were thrown from the same directions as those in the south-west, as though the forces acting in this section had burst through the barriers of the central line, or, finding them defective, had swept on through the north-west quadrant, thus giving a zigzag shape to this area.

Appearances seem to indicate that the work of destruction began and progressed throughout all parts of each area almost if not quite simultaneously.

During the tornado of Dec. 22, 1884, in Clarendon County, a lady, perceiving the approach of the storm, was in the act of closing a glazed door, which extended down to the floor and opened on a piazza; but before she could fasten it, the house was enveloped by the tempest, the door flew open, and she was drawn out and dashed violently against the balustrade running around the piazza, and received injuries and bruises which confined her to bed for several weeks. In the same room there was a heavy pine press, the door of which was locked. This door was burst open, torn from its hinges, and, in the language of the narrator, "shivered into kindling splinters." There was no other damage done to the house, at least none mentioned. I have examined the tracks of three tornadoes, — April 23, 1883; Feb. 19, 1884; and Dec. 22, 1884, — and they corresponded so exactly in their various parts, that the conviction is irresistible that the features described, especially those indicating the directions and order in which the forces acted, will be invariably found in the track of every tornado.

Notwithstanding the intense atmospheric disturbance, which, judging from ordinary thunder-storms, is of just such a character as to produce vast supplies of electricity, the usual electrical manifestations, lightning and thunder, are tame, and out of all proportion to the intensity of the atmospheric disturbance in the tornado as compared with an ordinary thunder-storm. In the tornado there are never, I think, any discharges from the clouds to the earth; objects are never struck by lightning; the thunder, when it occurs, is always high up among the clouds, and rolls away across the sky in long reverberating peals; showing that the static electricity is confined to the upper clouds, and the supply by no means superabundant. What, then, becomes of the electricity of the lower clouds? Does it remain dormant, or does it in some way aid in the destruction?

W. W. ANDERSON, M.D.

Stateburg, S.C.

The Study of Languages.

IN the number of *Science* issued July 8 of this year, p. 19, is the following passage: "The advantages of the ability to read an ordinary classical author without the aid of a dictionary are so obvious as to need no comment."

I was called from home immediately after reading the above, hence my delay in seeking from the writer an extended explanation of the means by which the student can read an ordinary Latin author without a dictionary.

Is there really any practical method by which he can accomplish this, except by employing his dictionary so faithfully that he has no further use for it?

I do not believe an accurate knowledge of a language can be acquired by reading at sight one page or any number of pages, unless the student comprehends the exact signification of each word as he passes it. It is true, such an exercise increases his facility in understanding the words and sentences he has already studied.

Reading aloud over and over again what one has already read, together with committing to memory poems and passages from prose authors, is, I believe, the best if not the only practical method of acquiring an ability of reading Latin or any language at sight.

H. L. E.

Chicago, Dec. 20.

Queries.

20. STAR OF BETHLEHEM. — I see paragraphs going the rounds of the papers about the 'Star of Bethlehem,' that is claimed to be a binary system, and to give its maximum light once in three hundred years. Some claim it was the star in the east, seen by the wise men. Please tell us in *Science* if there is anything in these rumors, and, if so, where in the heavens the star can be seen.

JOHN D. PARKER.

Fort Riley, Kan., Dec. 24.

21. GLOBULAR LIGHTNING. — The following report from the Hydrographic Office relates to one of the rarest and most inexplicable forms of lightning. Can any of the readers of *Science* give any information on the subject? A globe of fire floats leisurely along in the air in an erratic sort of a course, sometimes exploding with great force, at other times disappearing without exploding. On land it has been observed to go into the ground and then reappear at a short distance, and where it entered the soil it left a rugged hole some twenty feet in diameter. Although there is no doubt as to the facts regarding the phenomenon, no satisfactory explanation of the cause has ever been given. It is, of course, entirely different in character from St. Elmo's fires, so often seen on board vessels during thunder-storms: these remain stationary at the yard-arms and mast-heads, and are analogous to the 'brush discharge' of an electric machine. Captain Moore, British steamship 'Siberian,' reports, "Nov. 12, midnight, Cape Race bearing west by north, distant ten miles, wind strong south by east, a large ball of fire appeared to rise out of the sea to a height of about fifty feet, and come right against the wind close up to the ship. It then altered its course, and ran along with the ship to a distance of about one and one-half miles. In about two minutes it again altered its course, and went away to the south-east against the wind. It lasted, in all, not over five minutes. Have noticed the same phenomenon before off Cape Race, and it seemed to indicate that an easterly or south-easterly gale was coming on."